The Course

Autonomous Systems
Sistemi Autonomi

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Alma Mater Studiorum – Università di Bologna

Academic Year 2015/2016

Outline

Autonomous Software Creatures?

Autonomous Robot Toys?

Autonomous Vacuum Cleaners?

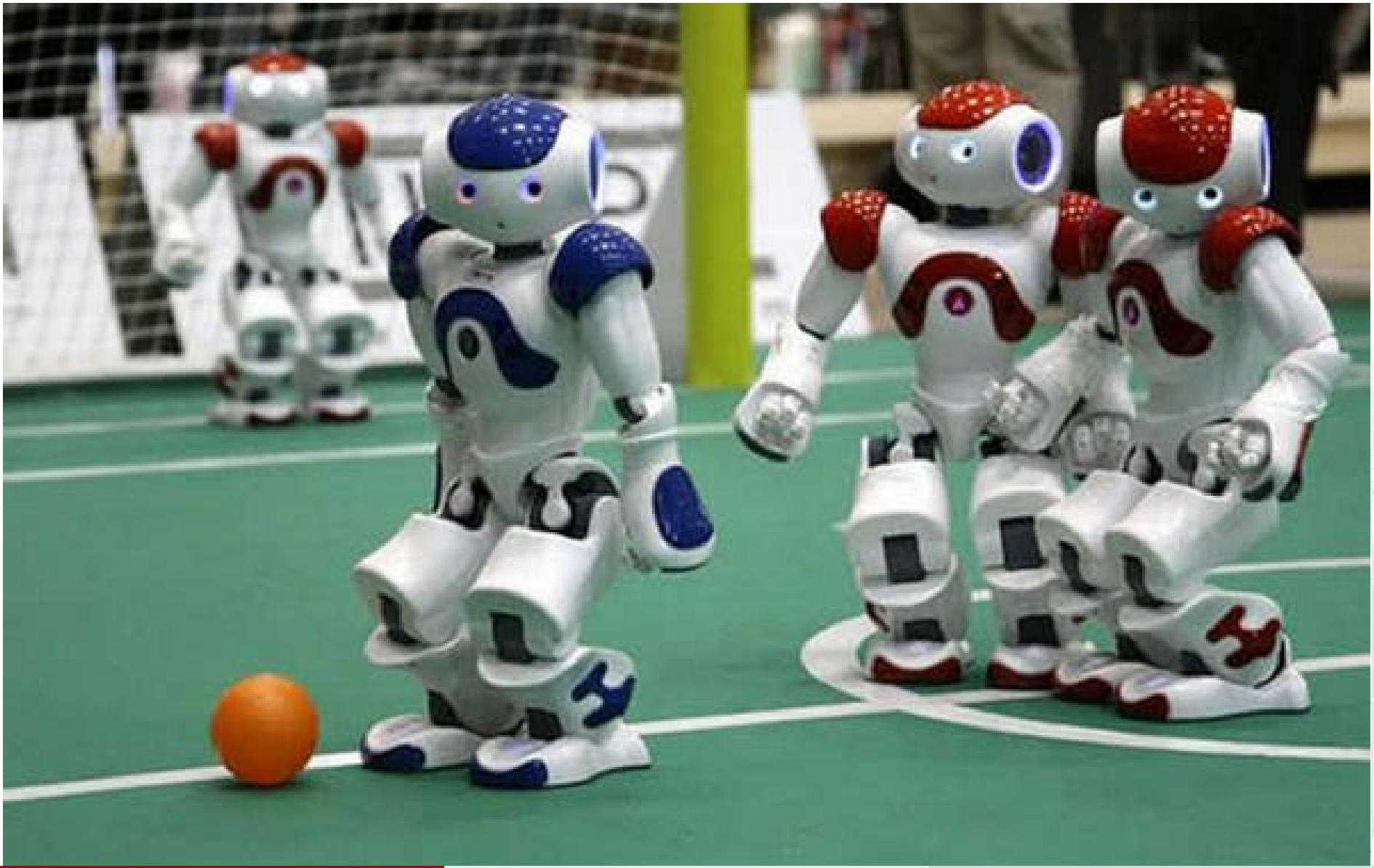
Autonomous Lawnmowers?

Autonomous Aircrafts?

Autonomous Cars?

Autonomous Weapons?

Autonomous Soccer Players & Teams?



Outline

Why Should We Bother? I

Social pressure

- Not just hard physical work: heavy unproductive mind work, and non-qualified time consuming activities, too, are no longer so acceptable for human beings
- Activities that might be *delegated* to *artificial systems* grow in *number* and *complexity*

Why Should We Bother? II

Gap

- People already have "somehow autonomous" systems at home and at work, and ask for more
- Engineers are not yet trained on *general approaches* to build *autonomous systems*
- We do not have, yet, a clear, shared, well-founded definition of the notion of autonomous system

Why Autonomy?

Who does what?

- Mostly, this is no longer an issue
- Artificial system are generally very welcome to do whatever we like

! This also raises the issue of

autonomous components vs. autonomous systems

Who takes the decision?

- Autonomy is at least about *deliberation* as much as about *action*
- *E.g.*, for artificial weapons, the question is not just

who pulls the trigger?

but also / rather

who decides to pull the trigger?

Why Systems?

We are *computer scientists & engineers*

- We do *model* and *build* computational systems
- More generally, we deal with *artificial* systems, with a relevant / crucial / essential computational part

Why Computational Systems?

Focus on computation

- Artificial systems of any sort are more and more affected by their computational part
- Manufacturing, automatic systems, automotive systems, telecom, energy, . . . : wherever we look, we find an ever-increasing relevance of computational-based approaches
- Looking ahead, facing the issue of autonomous systems from a *computer science / engineering viewpoint* seemingly brings no significant lack of generality

Why Socio-technical Systems?

Humans in the Loop

- *Socio-technical systems* (STS) arise when cognitive and social interaction are mediated by information technology, rather than by the natural world alone
- In other words, any system in which the infrastructure enabling and constraining interaction is technological, but the evolution of the system is *driven* by social and cognitive interactions, is a STS
- STS have *humans in the loop*
- and so autonomy in STS has humans in the loop, too

Outline

Details

AMS

- Autonomous Systems (*Sistemi Autonomi*), A.A. 2015/2016
- Course Code 69897
- `http://apice.unibo.it/xwiki/bin/view/Courses/Sa1516`

Communication

- Professor-students mailing list

  `andrea.omicini.SA-1516`

- Password

  `1516SA`

- Subscribe *today*!

Lessons

Timetable

- Tuesday 9-11, Room D
- Tuesday 11-13, Room D / Lab 3

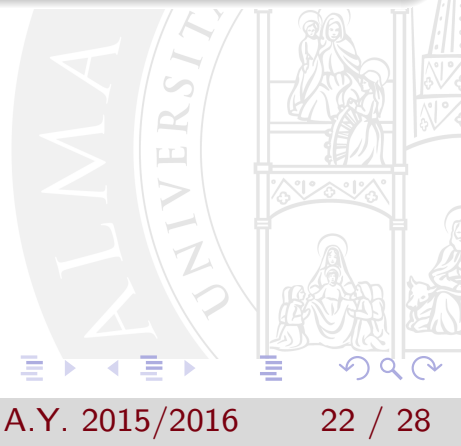
In class

- After some theoretical introduction, the students will be involved in projects and small presentations
- When and how, it depends on how many students will *actually* follow the lessons
- The goal is to *complete* the projects and presentations, and *pass* the exam as soon as possibile – maybe before the end of the year

Content I

Autonomy in software systems and in artificial systems

- Autonomy in biology, philosophy, sociology, law
- The different meanings of autonomy in artificial systems and software systems
- Automatics vs. autonomic vs. autonomous
  - autonomous systems vs. autonomous components



Content II

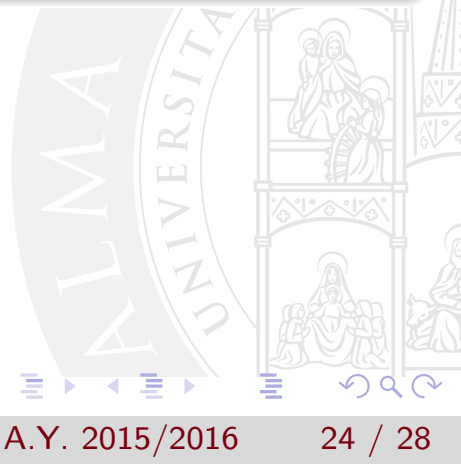
Intelligence and autonomy in software systems

- Intelligent agents
  - Architectures for intelligent agents
- Intelligent agent systems
  - Coordinated systems
  - Agents and artefacts
  - Workflow Management
- Social and collective intelligence
  - Swarm intelligence
  - Stigmergic coordination
  - Stochastic systems
- Adaptability and self-organisation
  - Pervasive Systems
  - Self-organising coordination

Content III

Technologies for autonomous systems

- Logical agents in tuProlog
- Intelligent agents in JADE / WADE, *Jason*, and CArtAgO
- Workflow, coordinated, adaptive, stochastic, and self-organising systems in TuCSoN e ReSpecT
- Agent games in AMUSE



Project

- Projects & themes will be assigned after some discussion in October / early November at most
- Ideally, they should imply both theoretical and technical work
- Individual / small groups projects

Exam

- Discussion of the project
- Should be *done* by mid December—for those attending classes
  - others will have standard projects to prepare and discuss, starting from next year

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